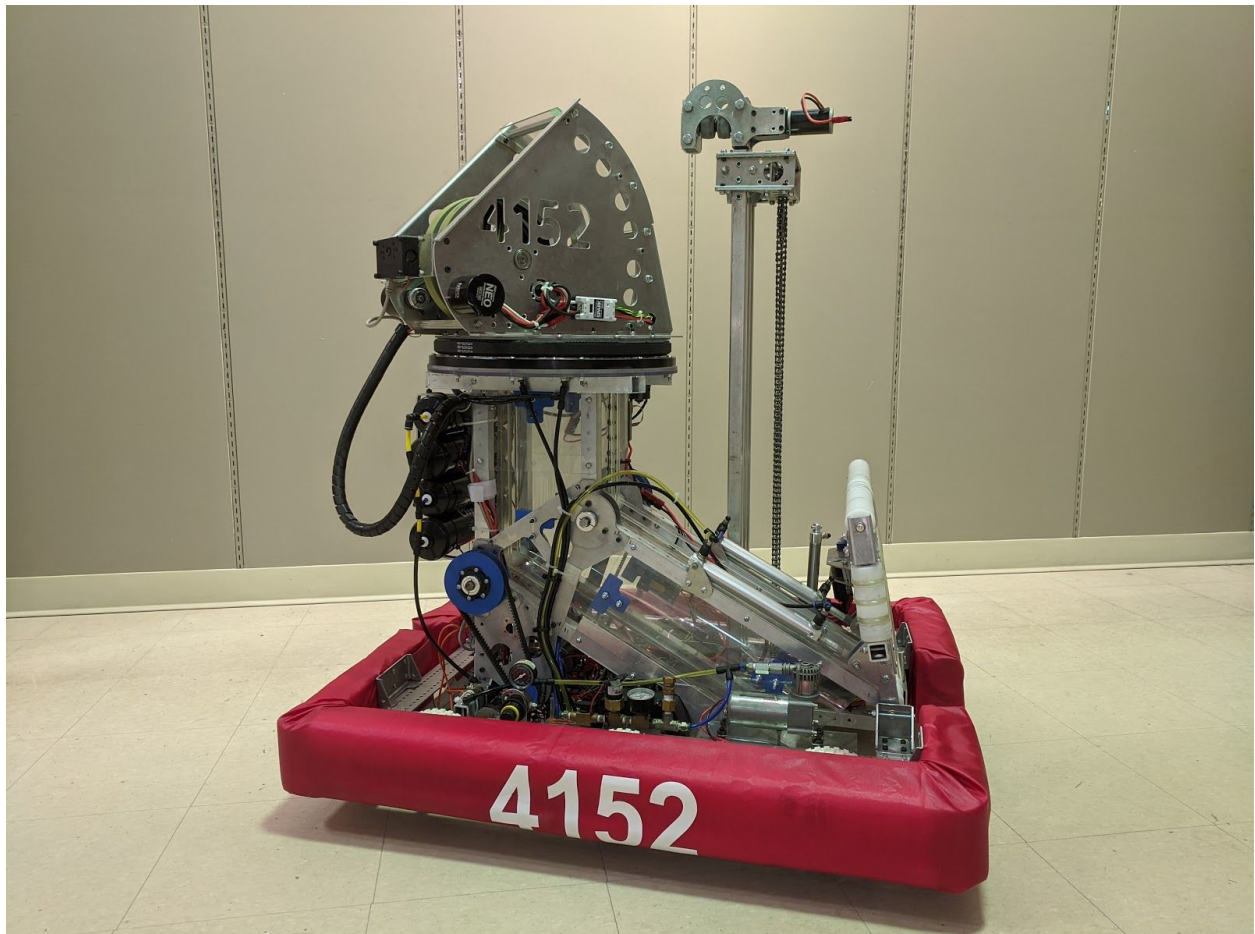




Hoya Robotics Team 4152

Technical Binder 2020 Season



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Thank yous



Thank you to our sponsors and our supporters:
Don Cowan, Sue Barker, Catherine Stutt and many more...

Having practice space at the Huntsville Place mall allowed our team to fine-tune our robot with all the game elements that were built by our build captain, Liam Martin-McTavish.

Analysis

Game Analysis and Strategy

Our first priority was for students to take a rules test to ensure the rules were understood. Scenarios were worked out showing different ways points could be generated.

Scenario 2 - 2 moderately good robots

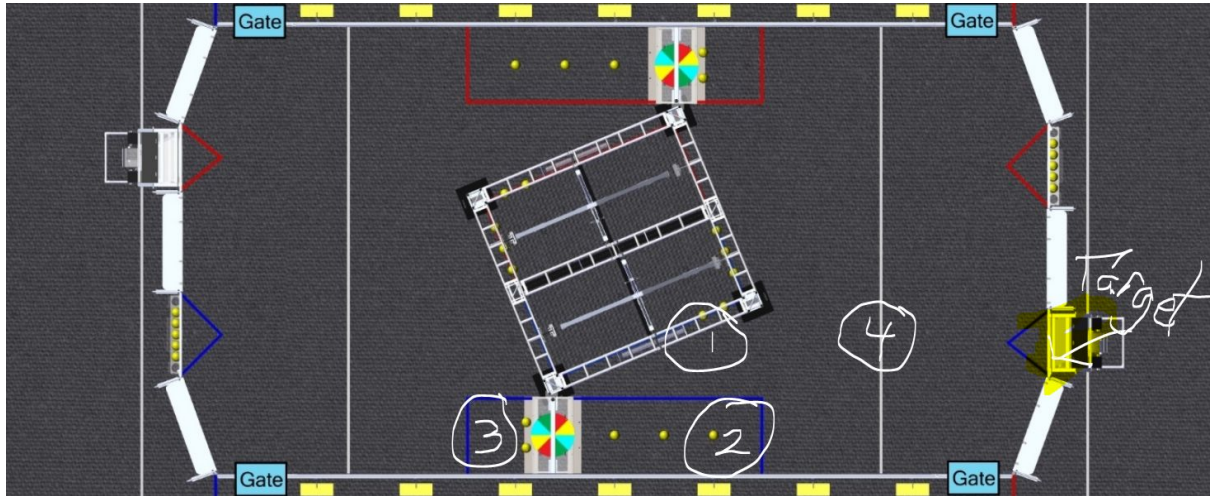
Infinite Recharge Ways to earn points									
Auto	Point Value	Robot 1	Robot 1 Points	Robot 2	Robot 2 Points	Robot 3	Robot 3 Points	Total Points	
Initiation Line	5	5	5	5	5	0	0	10	
Bottom Port	2	3	6	1	2	1	2	10	
Outer Port	4	0	0	0	0	0	0	0	
Inner Port	6	0	0	0	0	0	0	0	
Teleop		0	0	0	0	0	0	0	
Bottom Port	1	0	0	0	0	0	0	0	
Outer Port	2	24	48	10	20	10	20	88	
Inner Port	3	0	0	0	0	0	0	0	
Rotational Control	10	1	10	0	0	0	0	10	
Position Control	20	1	20	0	0	0	0	20	
Hang	25	1	25	1	25	0	0	50	
Park	5	0	0	0	0	0	0	0	
Level	15	1	15	0	0	0	0	15	
Stage 1 Activated								Stage 1 in Teleop	
Stage 2 Activated								Stage 2	
Stage 3 Activated								Stage 3	
65 Endgame points	1RP							1RP	
Stage 3 Activated	1 RP							1RP	
Tie	1 RP								
Win	1RP							203	

Previous games were analyzed to determine potential cycle times and strategies. A variety of strategies were brainstormed and decision matrices were used to prioritize them.

Strategy Decisions

The following priorities were established:

1. Being able to shoot to Outer Level from the following general areas with a minimum of 95% accuracy.



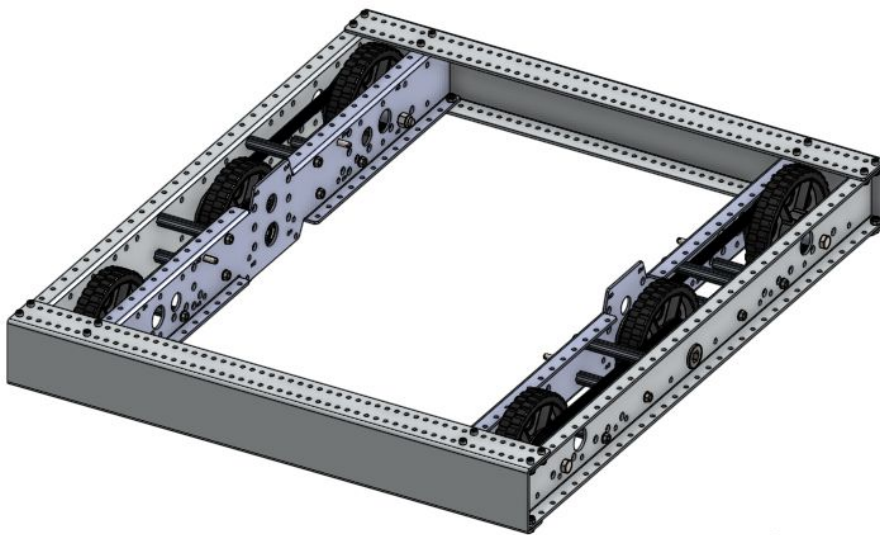
2. Be able to pick up Power Cells from the floor very quickly (touch it - own it)
These two require our drive train to be robust with quick acceleration and the ability to handle defense
3. Use vision processing to automate targeting and power cell pickup
4. Be able to consistently hang from the shield
5. Be able to consistently manipulate the control panel with a colour sensor

We decided early on that it was more important to do our top three priorities really well instead of trying to do everything poorly. Space was established for ensuring we could implement items 4 and 5 later in the season so they would be fine tuned.

Robot Design

Drivetrain

In the fall we built our custom design S & T drivetrain. We were excited about the design, but decided that the time required to manufacture the parts in competition would take away from time we could spend on other components. As such we stuck with the Kit of Parts drivetrain as we know it is reliable and we can quickly assemble it.



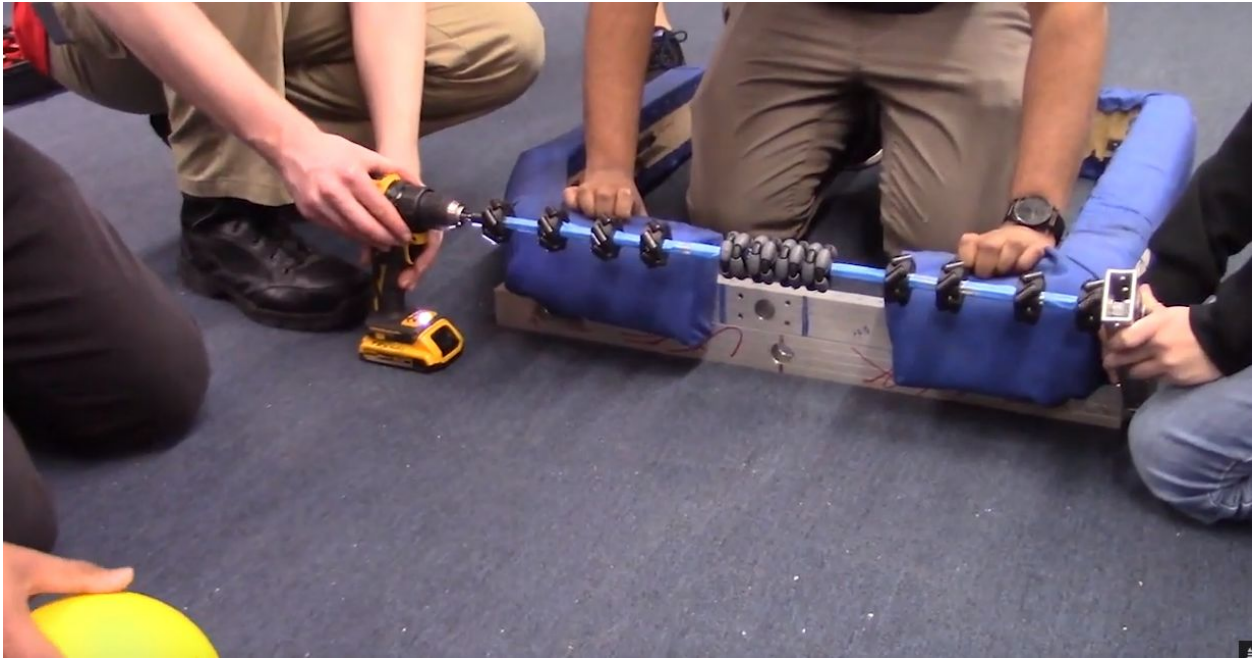
Gearbox



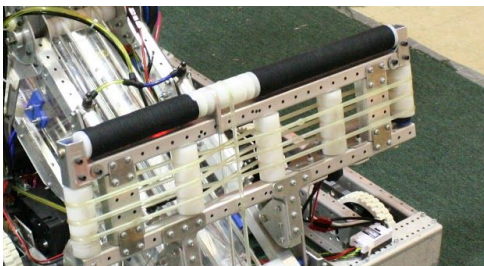
Thanks to ShawCor, our major sponsor for this year, we were able to purchase shifting gearboxes and Falcon motors for our drive train. Last year we noticed teams with shifting gearboxes had a distinct advantage when dealing with defense. Our goal is to be a fast robot that can shift into low gear to handle defense situations. Using Falcon motors we are starting to use brushless technology which greatly increases the power our motor can handle. We used two motors on each size to ensure we weren't drawing too many amps.



Intake

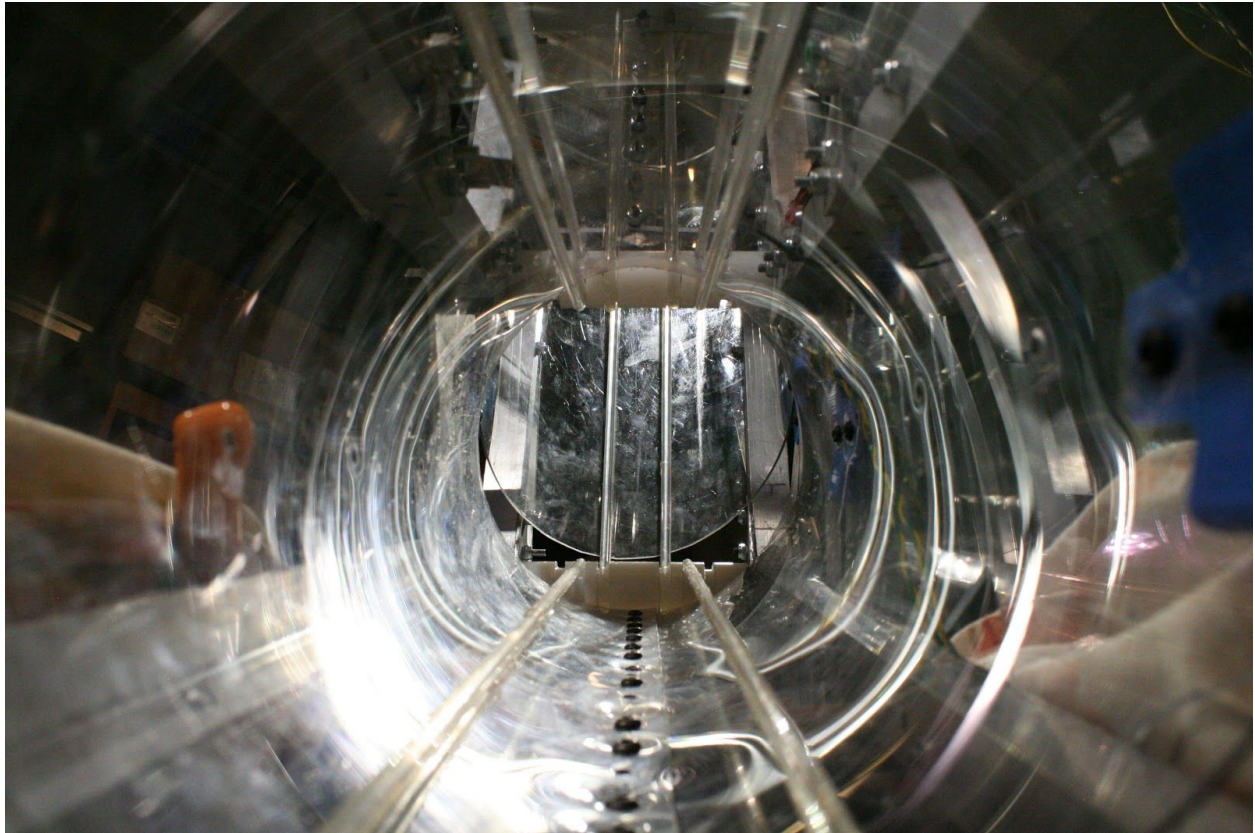


When prototyping intakes we started with mecanum wheels. Robot in 3 days was a successful example of using them. We weren't happy with the initial prototype and were concerned that the system needed to not only intake power cells but also follow the "Touch it, own it" philosophy. After exploring successful intakes from 2012 (steal from the best, invent the rest) we decided to try a polycord system. By crossing the polycord we were able to draw in power cells from either side allowing our robot to have an intake that took up the entire width of the robot. Our bumpers were designed with a slick material to ensure the balls slid across them. We had 3 polycord but found the forces in two directions created pinch points so we reduced it to one polycord into the robot.



In order to package our robot within the size constraints we used bushings instead of bearings so we could use 1x1 square tubing. The intake is powered by a Neo 550 motor to ensure small packaging.

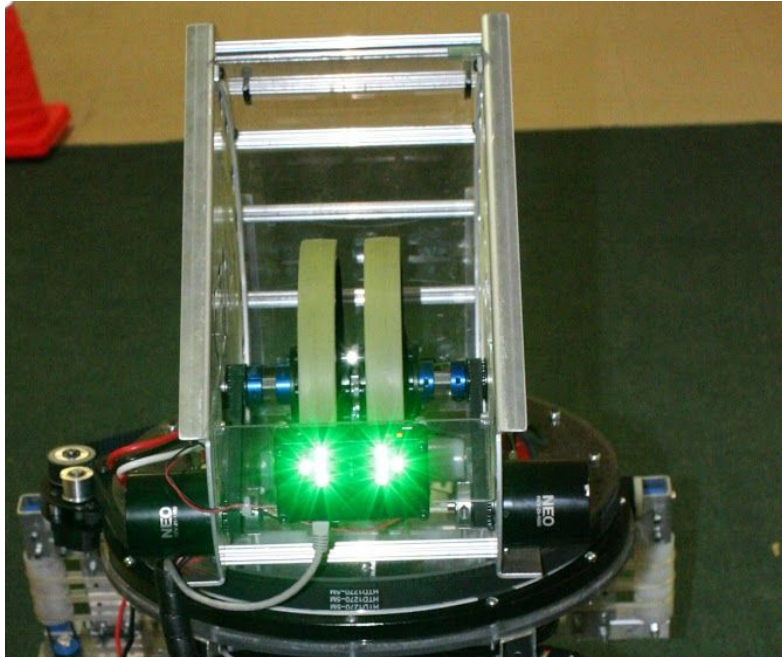
Power Cell Storage



Our storage system is angled up to ensure no contact with the gearboxes. We also decided to use a tall robot as the height would be an advantage when shooting from a long distance which fit our strategic priority. By shooting behind the colour wheel we could reduce cycle times by having a shorter distance to travel. Using the sheet metal feature in onShape we were able to design the tube and then flatten it so we could cut it out. We custom designed T braces that were 3d printed allowing us to secure the tubes.

The rollers are run by Mini-Cim motors - allowing us to help lower our centre of gravity due to their weight.

Turret



In order to shoot the power cells accurately and quickly we needed to ensure we weren't spending extra time lining the robot up with the target. Thanks to supporters of our team we were able to purchase a turret from Armabot. We knew we did not have the manufacturing capabilities to create the turret from scratch. The turret is powered with a 775pro motor and uses an encoder to establish positioning.

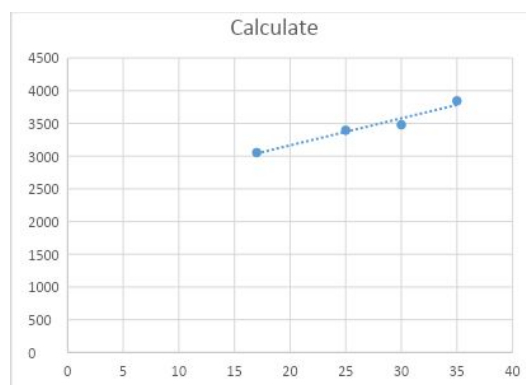
Shooter



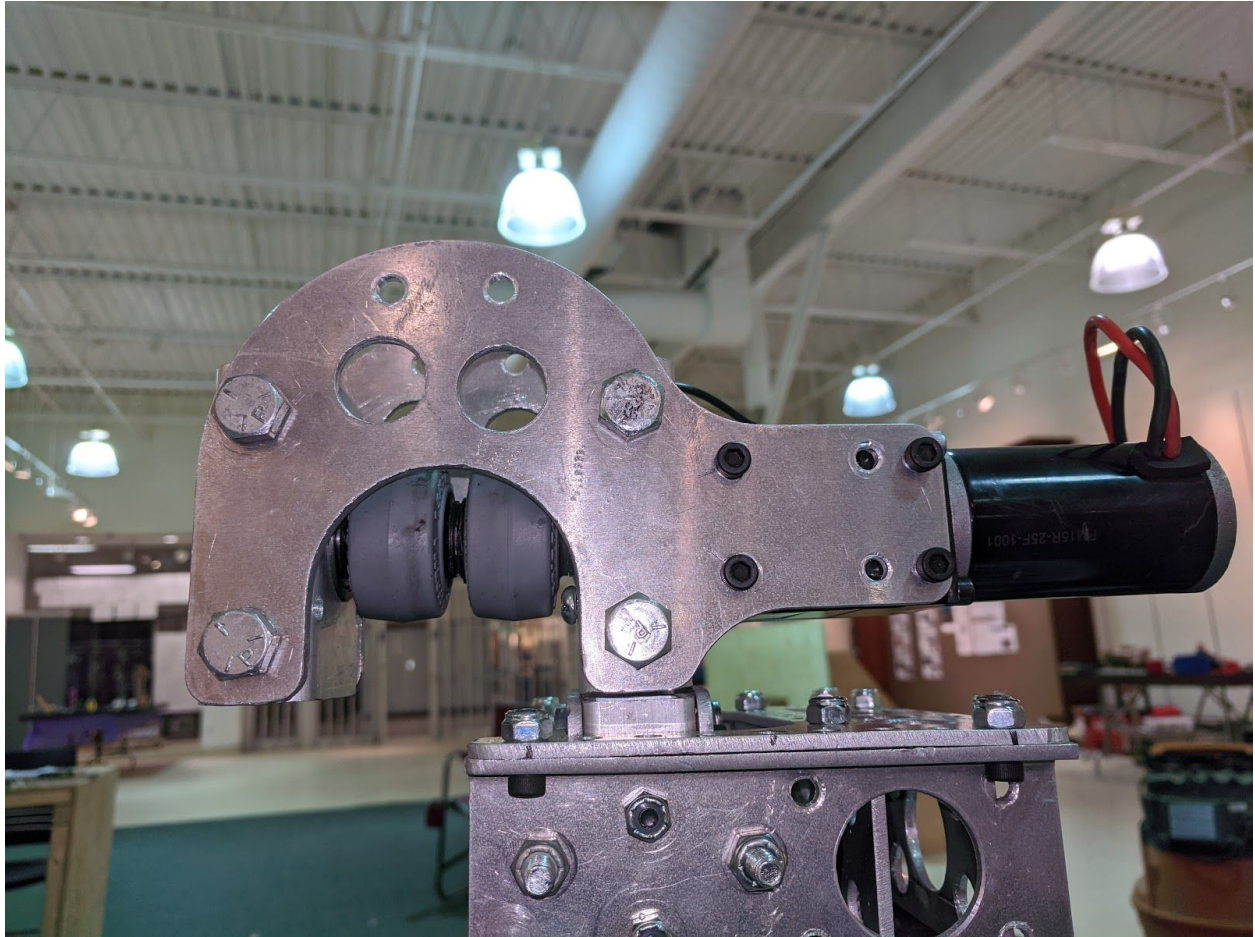
Over the last two years our grade 9 classes have built ball shooters for a variety of balls. This experience has allowed us to quickly prototype a shooter with multiple compression settings. By attaching 2x4 legs we quickly ran multiple tests until we found an angle that allowed us to shoot at our key strategic positions (33', 17'). We also designed our shooter so that we could use 775 pro motors (which we had) or Neo motors and incorporated multiple ways to mount encoders. During testing we determined that shooting at 35' would require the 775 pro motors to run at over 90%. We made the decision to switch to Neo motors because their increased efficiency would allow us to draw less battery power and give us more flexibility if we needed to increase RPM based on wear and tear of the power cells. For our target we drew a grid on the target and tracked multiple variables for hundreds of test shots.

This test shot data allowed to to determine the relationship between distance from the target and the RPM. Using Excel (sorry Google

Docs doesn't have all the features) we used a scatter plot graph and graphed the line of best fit. It also allowed us to display the equation for the line and the error value. Using these values we were able to automate the targeting process to increase our shooting accuracy.



Shield Climber



Due to space constraints we decided to use chain (rope would have required a spindle). To deal with chain stretch we re-used the chain from our Power-Up robot - #35 and pre stretched! We have a system in place to deal with any additional stretching. Being able to balance on the shield was important to achieve ranking points so we added colson wheels to our hook mechanism. We powered the wheels with a bag motor and a versaplanetary gearbox to keep it compact. This allows our robot to drive along the shield to balance. We are working on adding sensors to allow the robot to autonomously self-level.

In order to brake the system and prevent the robot from dropping down we used a wrench attached to a pneumatic cylinder to lock the hex shaft in place.

Programming

Our programming is done in Java, using the WPILib's command-based framework. Code is stored on <https://github.com/HoyaRobotics/InfiniteRecharge2020>, and effort has been made to document programming techniques for new students.

Vision Targeting

Cavalcade and TLDSB contributed to allow us to purchase a Limelight camera for our team and one for each of our children teams (GHS, BMLSS and FFSS). The Limelight allows us to align our turret towards the target and set the RPM for the shooter based on target distance. This has allowed us to be consistent in our shots from any position on the field.

Logging

The robot codebase includes a custom logger used to write messages to files. If an external USB is connected to the roboRIO, the files are saved there. Otherwise, the latest log file is found on the roboRIO file system. All messages are time stamped and can be given one of three levels of importance. This has allowed us to obtain exact measurements while testing the robot, especially the shooter.

Shooter Tech

Shooting power cells is made possible by the cooperation of three robot subsystems: the Limelight, the turret, and the shooter itself. The Limelight supplies the turret with the horizontal offset of the target so that the turret can align itself. It also supplies the shooter with the distance from the target (using trigonometry), so that it can adjust its RPM. The shooter's RPM is maintained using the SparkMAX's integrated PID functionality.

The Team

Team Mentors

Dwayne Verhey
Pam Nadrofsky
Nancy Topps
Steve Warren
Paula Boon
Daneen Waller
Wes Palmer

Ian McTavish
Dave Topps
Sam Topps
Debbie Reynolds
Debbie Cameron
Ron Wilkinson
Darryl Scott

Team Members

Co-captain: Oliver Byl
Build Captain: Liam Martin-McTavish
Testing: Hanna
Past captain: Keira
Media: James
Safety Captain: Gabe
3d printing and electronics: Caden
Build team: Billy
Design: William K.
Pit Crew: Drake
Electronics: Evin

Co-captain: Megan Cameron
Design: David Sinton
Pit Crew: Jaimie
Programming: Peter
Design: Alexander
Design: Jacob H
Electronics, driving: Morghan
CNC: Jeff
Build team: Ash
Programming: Quinn
Design: Will T.